

Carbon Dioxide Liquid-Measuring Devices

Device Description: _____

Contact Name: _____ Phone: _____

Company: _____ Address: _____

E-mail: _____ City: _____

Instructions For Completing Pre-Evaluation Checklists

You will usually need to complete **both** the “General” checklist and the specific checklist which is most applicable to your device or system type. For example, for a weighing device or weighing system the “General” checklist (which applies to all device types) and the “Scales” checklist should be completed. Both the “General” and “Watt-hour Meter” checklists should be completed and submitted with an electric watt-hour metering system application.

The exceptions are the computer software/hardware component pre-evaluation checklists which have the “General” requirements incorporated in them. Use the checklist for computer systems connected with either scales or measuring systems. Only one pre-evaluation checklist will be needed unless the software will be connected to both types of systems.

These checklists include requirements extracted from the California Code of Regulations. Though not all-encompassing, the checklists contain requirements beyond those which would apply to any single device type or accessory. It is best to think of a device type as a weighing or measuring device system or as a component of such a system whichever best describes the device(s).

When applying the requirements to your device you have three options; Check

YES	If your device or system complies
NO	if the device or system does not comply.
NA	if sections appear not to apply to the device or system type(s)

If selecting “**NO**”, consider if your device or system is ready for evaluation. If the deficiency is of such a nature that it will not effect the ability to test for accuracy, such as failure to conform with marking requirements or lack of provision for sealing, the evaluation can probably begin while deficiencies are being corrected.

If you are not able to conduct accuracy testing your system or device is probably not yet ready for an evaluation.

I have reviewed the enclosed specifications, tolerances, and test notes for the device type for which we have applied for evaluation and approval. To the best of my knowledge I have determined the device meets all applicable requirements.

Signed: _____

Date: _____

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4029. A. Application.
A.1. This code applies to carbon dioxide liquid measuring devices used for the measurement of liquid carbon dioxide.
A.2. This code does not apply to devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges.
A.3. The General Code provisions also apply to this device.

	Yes	No	NA
4029.1. S. Specifications.			
S.1. Design of indicating and recording elements and of recorded representations.			
S.1.1. Primary Elements.			
S.1.1.1. General. - A device shall be equipped with a primary indicating element and may also be equipped with a primary recording element.			
S.1.1.2. Units. - A device shall indicate and record, if equipped to record, its deliveries in terms of pounds or kilograms; or decimal subdivisions or multiples thereof.			
S.1.1.3. Value of Smallest Unit. - The value of the smallest unit of indicated delivery, and recorded delivery, if the device is equipped to record, shall not exceed the equivalent of: (a) for small delivery devices: (1) one pound, or (2) one kilogram. (b) for large delivery devices: (1) ten pounds, or (2) ten kilograms.			
S.1.1.4. Advancement of Indicating and Recording Elements. - Primary indicating and recording elements shall be susceptible of advancement only by the normal operation of the device. However, a device may be cleared by advancing its elements to zero, but only if: (a) the advancing movement, once started, cannot be stopped until zero is reached; or (b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.			
S.1.1.5. Return to Zero. - Primary indicating and recording elements shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of primary indicating elements and of primary recording elements beyond their correct zero position.			
S.1.2. Graduations.			
S.1.2.1. Length. - Graduations shall be so varied in length that they may be conveniently read.			

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	Yes	No	NA
S.1.2.2. Width. - In any series of graduations, the width of a graduation shall in no case be greater than the width of the clear interval between graduations. The width of main graduations shall be not more than 50 percent greater than the width of subordinate graduations. Graduations shall in no case be less than 0.008 inch in width.			
S.1.2.3. Clear Interval Between Graduations. - The clear interval shall be not less than 0.04 inch. If the graduations are not parallel, the measurement shall be made: (a) along the line of relative movement between the graduations at the end of the indicator, or (b) if the indicator is continuous, at the point of widest separation of the graduations.			
S.1.3. Indicators.			
S.1.3.1. Symmetry. - The index of an indicator shall be of the same shape as the graduations at least throughout that portion of its length associated with the graduations.			
S.1.3.2. Length. - The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 0.04 inch.			
S.1.3.3. Width. - The width of the index of the indicator in relation to the series of graduations with which it is used shall be not greater than: (a) the width of the widest graduation, and (b) the width of the minimum clear interval between graduations. When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.			
S.1.3.4. Clearance. - The clearance between the index of an indicator and the graduations shall in no case be more than 0.06 inch.			
S.1.3.5. Parallax. - Parallax effects shall be reduced to the practicable minimum.			
S.1.3.6. Travel of Indicator. - If the most sensitive element of the primary indicating element utilizes an indicator and graduations, the relative movement of these parts corresponding to the smallest indicated value shall be no less than 0.20 inch.			
S.1.4. Computing-Type Devices.			
S.1.4.1. Printed Ticket. - Any printed ticket issued by a device of the computing type on which there is printed the total computed price shall have printed clearly thereon also the total quantity of the delivery and the price per unit.			

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	Yes	No	NA
<p>S.1.4.2. Money-Value Computations. - Money-value computations shall be of the full-computing type in which the money value at a single unit price, or at each of a series of unit prices, shall be computed for every delivery within either the range of measurement of the device or the range of the computing elements, whichever is less.</p> <p>The total price shall be computed on the basis of the quantity indicated when the value of the smallest division indicated is equal to or less than the value specified in S.1.1.3.</p>			
<p>S.1.4.3. Money-Values, Mathematical Agreement. - Any digital money-value indication and any recorded money value on a computing-type device shall be in mathematical agreement with its associated quantity indication or representation to within one cent of money value.</p>			
<p>S.2. Design of Measuring Elements.</p> <p>S.2.1. Vapor Elimination. - A measuring system shall be equipped with an effective vapor eliminator or other effective means to prevent the measurement of vapor that will cause errors in excess of the applicable tolerances.</p>			
<p>S.2.2. Reverse Flow Measurement. - Effective means, automatic in operation, shall be installed to prevent reverse flow measurement.</p>			
<p>S.2.3. Maintenance of Liquid State. - A device shall be so designed that the product being measured will remain in a liquid state during passage through the device.</p>			
<p>S.2.4. Automatic Temperature or Density Compensation. - A volumetric device shall be equipped with automatic means for adjusting the indication and registration of the measured quantity of the product to the quantity of the measurement in terms of pounds.</p>			
<p>S.2.5. Provision for Sealing. - Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange may be made of:</p> <p>(a) any measuring or indicating element,</p> <p>(b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries,</p> <p>(c) any automatic temperature or density compensating system, and</p> <p>(d) any metrological parameter that will affect the metrological integrity of the device or system.</p> <p>When applicable any adjusting mechanism shall be readily accessible for purposes of affixing a security seal.</p> <p><i>[Audit trails shall use the format set forth in Table S.2.5.]* (See page 8)</i></p>			
<p>S.2.6. Mass Flow Meters. - An automatic means to determine and correct for changes in product density shall be incorporated in any mass flow metering system that is affected by changes in the density of the product being measured.</p>			

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	Yes	No	NA
S.3. Design of Discharge Lines and Discharge Line Valves. S.3.1. Diversion of Measured Liquid. - No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the device or the discharge line therefrom, except that a manually controlled outlet that may be opened for purging or draining the measuring system shall be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the device and to indicate clearly and unmistakably when the valve controls are so set as to permit passage of liquid through such outlet.			
S.3.2. Discharge Hose. - The discharge hose of a measuring system shall be of a wet hose type with a shutoff valve at its outlet end.			
S.4. Marking Requirements. S.4.1. Limitation of Use. - If a measuring system is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently marked on the device.			
S.4.2. Discharge Rates. - A meter shall be marked to show its designed maximum and minimum discharge rates. The marked minimum discharge rate shall not exceed 20 percent of the maximum discharge rate.			
S.5. Level Condition, On-Board Weighing Systems. - Provision shall be made for automatically inhibiting the delivery of liquid carbon dioxide when the vehicle is out of level beyond the limit required for the performance to be within the applicable tolerances.			
4029.2. N. Notes. N.1. Test Liquid. - The test liquid shall be carbon dioxide in a compressed liquid state.			
N.2. Vaporization and Volume Change. - Care shall be exercised to reduce vaporization and volume changes to a minimum. When testing by weight, the weigh tank and transfer systems shall be precooled to liquid temperature prior to the start of the test to avoid the venting of vapor from the vessel being weighed.			
N.3. Test Drafts. N.3.1. Gravimetric Test. - Weight test drafts shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate.			
N.3.2. Transfer Standard Test. - When comparing a meter with a calibrated transfer standard, the test draft shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate.			
N.3.3. Volumetric Prover Test Drafts. - Test drafts shall be equal to at least the amount delivered in one minute at normal discharge rate.			

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	Yes	No	NA
N.4. Testing Procedures.			
N.4.1. Normal Tests. - The "normal" test of a device shall be made at the maximum discharge flow rate developed under the conditions of installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.			
N.4.2. Special Tests. - Any test except as set forth in N.4.1. shall be considered a special test. Tests shall be conducted, if possible, to evaluate any special elements or accessories attached to or associated with the device. A device shall be tested at a minimum discharge rate of: (a) not less than the minimum rated capacity or 20 percent of the maximum rated discharge rate of the device, whichever is less, or (b) the lowest discharge rate practicable under the conditions of installation. "Special" tests may be conducted to develop any characteristics of the device anticipated under the conditions of installation as circumstances require.			
N.4.3. Density. - Temperature and pressure of the metered test liquid shall be measured during the test for the determination of density or volume correction when applicable. Table 1 (see page 8), contained in this Article, shall apply.			
N.4.4. Automatic Temperature or Density Compensation. - If a device is equipped with an automatic temperature or density compensator, the compensator shall be tested by comparing the quantity indicated or recorded by the device (with the compensator connected and operating) with the actual delivered quantity. Table 1 (see page 8) shall apply.			
4029.4. T. Tolerances.			
T.1. Application.			
T.1.1. To Underregistration and to Overregistration. - The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.			
T.2. Tolerance Values.			
T.2.1. On Normal Tests. - The maintenance tolerance on "normal" tests shall be two and one-half percent (2-1/2%) of the indicated quantity. The acceptance tolerances shall be one and one-half percent (1-1/2%) of the indicated quantity.			
T.2.2. On Special Tests. - The maintenance and acceptance tolerance on "special" tests shall be two and one-half percent (2-1/2%) of the indicated quantity.			
T.3. On Tests Using Transfer Standards. - To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard when compared to a basic reference standard.			

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4029.6. Definitions of Terms.

The terms defined here have a special and technical meaning when used in the Code for Carbon Dioxide Liquid-Measuring Devices.

automatic temperature or density compensation. - The use of integrated or ancillary equipment to obtain, from the output of a volumetric meter, an equivalent mass indication.

carbon dioxide liquid-measuring device. - A system including a mechanism or machine of (a) the meter or mass-flow type, or (b) a weighing type of device mounted on a vehicle designed to measure and deliver liquid carbon dioxide. Means may be provided to indicate automatically, for one of a series of unit prices, the total money value of the quantity measured.

large-delivery devices. - Devices used primarily for single deliveries greater than 1 000 pounds or 500 kilograms.

mass flow meter. - A device that measures the mass of a product flowing through the system. The mass measurement may be determined directly from the effects of mass on the sensing unit or may be inferred by measuring the properties of the product, such as the volume, density, temperature, or pressure, and displaying the quantity in mass units.

small-delivery device. - Any device other than a large-delivery device.

transfer standard. - A measurement system designed for use in proving and testing carbon dioxide liquid-measuring devices.

vapor equalization credit. - The quantity deducted from the metered quantity of liquid carbon dioxide when a vapor equalizing line is used to facilitate the transfer of liquid during a metered delivery.

vapor equalization line. - A hose or pipe connected from the vapor space of the seller's tank to the vapor space of the buyer's tank that is used to equalize the pressure during a delivery.

wet-hose type. - A type of device in which it is intended that the discharge hose be completely filled prior to each commercial delivery.

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Table S.2.5. Categories of Device and Methods of Sealing	
Category of Device	Method of Sealing
Category 1: No remote configuration capability.	Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability, but access is controlled by physical hardware. The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.	The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password). The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.	An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)

[Nonretroactive as of January 1, 1995]

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TABLE 1

Temp Deg F	Pressure		Liquid Density			Vapor Density		Vap Dis %
	PSIA	PSIG	lb/gal	(lb-oz)/gal		lb/cu ft	lb/gal	
-30.00	177.89	163.19	9.127	9	- 2.0	1.989	0.266	2.9
-29.75	178.75	164.05	9.122	9	- 2.0	1.999	0.267	2.9
-29.50	179.62	164.92	9.117	9	- 1.9	2.008	0.268	2.9
-29.25	180.49	165.79	9.113	9	- 1.8	2.018	0.270	3.0
-29.00	181.36	166.67	9.108	9	- 1.7	2.028	0.271	3.0
-28.75	182.24	167.54	9.103	9	- 1.7	2.038	0.272	3.0
-28.50	183.12	168.42	9.098	9	- 1.6	2.048	0.274	3.0
-28.25	184.00	169.31	9.094	9	- 1.5	2.058	0.275	3.0
-28.00	184.89	170.19	9.089	9	- 1.4	2.067	0.276	3.0
-27.75	185.78	171.08	9.084	9	- 1.3	2.077	0.278	3.1
-27.50	186.67	171.98	9.080	9	- 1.3	2.087	0.279	3.1
-27.25	187.57	172.87	9.075	9	- 1.2	2.098	0.280	3.1
-27.00	188.47	173.77	9.070	9	- 1.1	2.108	0.282	3.1
-26.75	189.37	174.67	9.065	9	- 1.0	2.118	0.283	3.1
-26.50	190.28	175.58	9.061	9	- 1.0	2.128	0.284	3.1
-26.25	191.18	176.49	9.056	9	- 0.9	2.138	0.286	3.2
-26.00	192.10	177.40	9.051	9	- 0.8	2.148	0.287	3.2
-25.75	193.01	178.32	9.046	9	- 0.7	2.159	0.289	3.2
-25.50	193.93	179.23	9.041	9	- 0.7	2.169	0.290	3.2
-25.25	194.85	180.16	9.037	9	- 0.6	2.179	0.291	3.2
-25.00	195.78	181.08	9.032	9	- 0.5	2.190	0.293	3.2
-24.75	196.70	182.01	9.027	9	- 0.4	2.200	0.294	3.3
-24.50	197.64	182.94	9.022	9	- 0.4	2.211	0.296	3.3
-24.25	198.57	183.87	9.017	9	- 0.3	2.221	0.297	3.3
-24.00	199.51	184.81	9.013	9	- 0.2	2.232	0.298	3.3
-23.75	200.45	185.75	9.008	9	- 0.1	2.243	0.300	3.3
-23.50	201.39	186.70	9.003	9	- 0.0	2.253	0.301	3.3
-23.25	202.34	187.64	8.998	9	- 0.0	2.264	0.303	3.4
-23.00	203.29	188.60	8.993	8	- 15.9	2.275	0.304	3.4
-22.75	204.25	189.55	8.989	8	- 15.8	2.286	0.306	3.4
-22.50	205.20	190.51	8.984	8	- 15.7	2.296	0.307	3.4
-22.25	206.16	191.47	8.979	8	- 15.7	2.307	0.308	3.4
-22.00	207.13	192.43	8.974	8	- 15.6	2.318	0.310	3.5
-21.75	208.09	193.40	8.969	8	- 15.5	2.329	0.311	3.5
-21.50	209.06	194.37	8.964	8	- 15.4	2.340	0.313	3.5
-21.25	210.04	195.34	8.959	8	- 15.4	2.351	0.314	3.5
-21.00	211.02	196.32	8.955	8	- 15.3	2.362	0.316	3.5
-20.75	212.00	197.30	8.950	8	- 15.2	2.374	0.317	3.5
-20.50	212.98	198.28	8.945	8	- 15.1	2.385	0.319	3.6
-20.25	213.97	199.27	8.940	8	- 15.0	2.396	0.320	3.6

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Temp Deg F	Pressure		Liquid Density			Vapor Density		Vap Dis lb/gal	%
	PSIA	PSIG	lb/gal	(lb-oz)/gal		lb/cu ft			
-20.00	214.96	200.26	8.935	8	- 15.0	2.407	0.322	3.6	
-19.75	215.95	201.26	8.930	8	- 14.9	2.419	0.323	3.6	
-19.50	216.95	202.25	8.925	8	- 14.8	2.430	0.325	3.6	
-19.25	217.95	203.25	8.920	8	- 14.7	2.441	0.326	3.7	
-19.00	218.95	204.26	8.915	8	- 14.6	2.453	0.328	3.7	
-18.75	219.96	205.27	8.911	8	- 14.6	2.464	0.329	3.7	
-18.50	220.97	206.28	8.906	8	- 14.5	2.476	0.331	3.7	
-18.25	221.99	207.29	8.901	8	- 14.4	2.488	0.333	3.7	
-18.00	223.01	208.31	8.896	8	- 14.3	2.499	0.334	3.8	
-17.75	224.03	209.33	8.891	8	- 14.3	2.511	0.336	3.8	
-17.50	225.05	210.36	8.886	8	- 14.2	2.523	0.337	3.8	
-17.25	226.08	211.38	8.881	8	- 14.1	2.534	0.339	3.8	
-17.00	227.11	212.42	8.876	8	- 14.0	2.546	0.340	3.8	
-16.75	228.15	213.45	8.871	8	- 13.9	2.558	0.342	3.9	
-16.50	229.18	214.49	8.866	8	- 13.9	2.570	0.344	3.9	
-16.25	230.23	215.53	8.861	8	- 13.8	2.582	0.345	3.9	
-16.00	231.27	216.58	8.856	8	- 13.7	2.594	0.347	3.9	
-15.75	232.32	217.62	8.851	8	- 13.6	2.606	0.348	3.9	
-15.50	233.37	218.68	8.846	8	- 13.5	2.618	0.350	4.0	
-15.25	234.43	219.73	8.841	8	- 13.5	2.630	0.352	4.0	
-15.00	235.49	220.79	8.836	8	- 13.4	2.643	0.353	4.0	
-14.75	236.55	221.86	8.831	8	- 13.3	2.655	0.355	4.0	
-14.50	237.62	222.92	8.826	8	- 13.2	2.667	0.357	4.0	
-14.25	238.69	223.99	8.821	8	- 13.1	2.680	0.358	4.1	
-14.00	239.76	225.07	8.816	8	- 13.1	2.692	0.360	4.1	
-13.75	240.84	226.14	8.811	8	- 13.0	2.704	0.362	4.1	
-13.50	241.92	227.22	8.806	8	- 12.9	2.717	0.363	4.1	
-13.25	243.00	228.31	8.801	8	- 12.8	2.729	0.365	4.1	
-13.00	244.09	229.39	8.796	8	- 12.7	2.742	0.367	4.2	
-12.75	245.18	230.49	8.791	8	- 12.7	2.755	0.368	4.2	
-12.50	246.28	231.58	8.786	8	- 12.6	2.767	0.370	4.2	
-12.25	247.37	232.68	8.781	8	- 12.5	2.780	0.372	4.2	
-12.00	248.48	233.78	8.776	8	- 12.4	2.793	0.373	4.3	
-11.75	249.58	234.89	8.771	8	- 12.3	2.806	0.375	4.3	
-11.50	250.69	236.00	8.765	8	- 12.2	2.819	0.377	4.3	
-11.25	251.80	237.11	8.760	8	- 12.2	2.832	0.379	4.3	
-11.00	252.92	238.22	8.755	8	- 12.1	2.845	0.380	4.3	
-10.75	254.04	239.34	8.750	8	- 12.0	2.858	0.382	4.4	
-10.50	255.16	240.47	8.745	8	- 11.9	2.871	0.384	4.4	
-10.25	256.29	241.60	8.740	8	- 11.8	2.884	0.386	4.4	

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Temp Deg F	Pressure		Liquid Density			Vapor Density		Vap Dis %
	PSIA	PSIG	lb/gal	(lb-oz)/gal		lb/cu ft	lb/gal	
-10.00	257.42	242.73	8.735	8	- 11.8	2.897	0.387	4.4
- 9.75	258.56	243.86	8.730	8	- 11.7	2.911	0.389	4.5
- 9.50	259.70	245.00	8.725	8	- 11.6	2.924	0.391	4.5
- 9.25	260.84	246.14	8.719	8	- 11.5	2.937	0.393	4.5
- 9.00	261.98	247.29	8.714	8	- 11.4	2.951	0.394	4.5
- 8.75	263.13	248.44	8.709	8	- 11.3	2.964	0.396	4.5
- 8.50	264.29	249.59	8.704	8	- 11.3	2.978	0.398	4.6
- 8.25	265.44	250.75	8.699	8	- 11.2	2.991	0.400	4.6
- 8.00	266.60	251.91	8.694	8	- 11.1	3.005	0.402	4.6
- 7.75	267.77	253.07	8.688	8	- 11.0	3.019	0.404	4.6
- 7.50	268.93	254.24	8.683	8	- 10.9	3.032	0.405	4.7
- 7.25	270.11	255.41	8.678	8	- 10.8	3.046	0.407	4.7
- 7.00	271.28	256.59	8.673	8	- 10.8	3.060	0.409	4.7
- 6.75	272.46	257.76	8.668	8	- 10.7	3.074	0.411	4.7
- 6.50	273.64	258.95	8.662	8	- 10.6	3.088	0.413	4.8
- 6.25	274.83	260.13	8.657	8	- 10.5	3.102	0.415	4.8
- 6.00	276.02	261.32	8.652	8	- 10.4	3.116	0.417	4.8
- 5.75	277.21	262.52	8.647	8	- 10.3	3.130	0.418	4.8
- 5.50	278.41	263.72	8.641	8	- 10.3	3.144	0.420	4.9
- 5.25	279.61	264.92	8.636	8	- 10.2	3.159	0.422	4.9
- 5.00	280.82	266.12	8.631	8	- 10.1	3.173	0.424	4.9
- 4.75	282.03	267.33	8.626	8	- 10.0	3.187	0.426	4.9
- 4.50	283.24	268.55	8.620	8	- 9.9	3.202	0.428	5.0
- 4.25	284.46	269.76	8.615	8	- 9.8	3.216	0.430	5.0
- 4.00	285.68	270.98	8.610	8	- 9.8	3.231	0.432	5.0
- 3.75	286.90	272.21	8.604	8	- 9.7	3.245	0.434	5.0
- 3.50	288.13	273.44	8.599	8	- 9.6	3.260	0.436	5.1
- 3.25	289.37	274.67	8.594	8	- 9.5	3.275	0.438	5.1
- 3.00	290.60	275.91	8.589	8	- 9.4	3.289	0.440	5.1
- 2.75	291.84	277.15	8.583	8	- 9.3	3.304	0.442	5.1
- 2.50	293.09	278.39	8.578	8	- 9.2	3.319	0.444	5.2
- 2.25	294.33	279.64	8.573	8	- 9.2	3.334	0.446	5.2
- 2.00	295.58	280.89	8.567	8	- 9.1	3.349	0.448	5.2
- 1.75	296.84	282.14	8.562	8	- 9.0	3.364	0.450	5.3
- 1.50	298.10	283.40	8.556	8	- 8.9	3.379	0.452	5.3
- 1.25	299.36	284.67	8.551	8	- 8.8	3.395	0.454	5.3
- 1.00	300.63	285.93	8.546	8	- 8.7	3.410	0.456	5.3
- 0.75	301.90	287.21	8.540	8	- 8.6	3.425	0.458	5.4
- 0.50	303.18	288.48	8.535	8	- 8.6	3.440	0.460	5.4
- 0.25	304.46	289.76	8.530	8	- 8.5	3.456	0.462	5.4

Carbon Dioxide Liquid-Measuring Devices

Temp Deg F	Pressure		Liquid Density			Vapor Density		Vap Dis %
	PSIA	PSIG	lb/gal	(lb-oz)/gal		lb/cu ft	lb/gal	
0.00	305.74	291.74	8.524	8	- 8.4	3.471	0.464	5.4
0.25	307.03	292.33	8.519	8	- 8.3	3.487	0.466	5.5
0.50	308.32	293.62	8.513	8	- 8.2	3.503	0.468	5.5
0.75	309.61	294.92	8.508	8	- 8.1	3.518	0.470	5.5
1.00	310.91	296.21	8.502	8	- 8.0	3.534	0.472	5.6
1.25	312.21	297.52	8.497	8	- 8.0	3.550	0.475	5.6
1.50	313.52	298.82	8.491	8	- 7.9	3.566	0.477	5.6
1.75	314.83	300.13	8.486	8	- 7.8	3.582	0.479	5.6
2.00	316.15	301.45	8.480	8	- 7.7	3.598	0.481	5.7
2.25	317.46	302.77	8.475	8	- 7.6	3.614	0.483	5.7
2.50	318.79	304.09	8.469	8	- 7.5	3.630	0.485	5.7
2.75	320.11	305.42	8.464	8	- 7.4	3.646	0.487	5.8
3.00	321.45	306.75	8.458	8	- 7.3	3.662	0.490	5.8
3.25	322.78	308.08	8.453	8	- 7.2	3.679	0.492	5.8
3.50	324.12	309.42	8.447	8	- 7.2	3.695	0.494	5.8
3.75	325.46	310.77	8.442	8	- 7.1	3.712	0.496	5.9
4.00	326.81	312.11	8.436	8	- 7.0	3.728	0.498	5.9
4.25	328.16	313.46	8.431	8	- 6.9	3.745	0.501	5.9
4.50	329.52	314.82	8.425	8	- 6.8	3.761	0.503	6.0
4.75	330.88	316.18	8.420	8	- 6.7	3.778	0.505	6.0
5.00	332.24	317.54	8.414	8	- 6.6	3.795	0.507	6.0
5.25	333.61	318.91	8.408	8	- 6.5	3.812	0.510	6.1
5.50	334.98	320.28	8.403	8	- 6.4	3.829	0.512	6.1
5.75	336.35	321.66	8.397	8	- 6.4	3.846	0.514	6.1
6.00	337.73	323.04	8.392	8	- 6.3	3.863	0.516	6.2
6.25	339.12	324.42	8.386	8	- 6.2	3.880	0.519	6.2
6.50	340.51	325.81	8.380	8	- 6.1	3.897	0.521	6.2
6.75	341.90	327.20	8.375	8	- 6.0	3.915	0.523	6.2
7.00	343.30	328.60	8.369	8	- 5.9	3.932	0.526	6.3
7.25	344.70	330.00	8.363	8	- 5.8	3.949	0.528	6.3
7.50	346.10	331.41	8.358	8	- 5.7	3.967	0.530	6.3
7.75	347.51	332.82	8.352	8	- 5.6	3.984	0.533	6.4
8.00	348.92	334.23	8.346	8	- 5.5	4.002	0.535	6.4
8.25	350.34	335.65	8.341	8	- 5.4	4.020	0.537	6.4
8.50	351.76	337.07	8.335	8	- 5.4	4.038	0.540	6.5
8.75	353.19	338.49	8.329	8	- 5.3	4.055	0.542	6.5
9.00	354.62	339.92	8.323	8	- 5.2	4.073	0.545	6.5
9.25	356.06	341.36	8.318	8	- 5.1	4.091	0.547	6.6
9.50	357.49	342.80	8.312	8	- 5.0	4.110	0.549	6.6
9.75	358.94	344.24	8.306	8	- 4.9	4.128	0.552	6.6

Carbon Dioxide Liquid-Measuring Devices

Temp Deg F	Pressure		Liquid Density			Vapor Density		Vap Dis %
	PSIA	PSIG	lb/gal	(lb-oz)/gal		lb/cu ft	lb/gal	
10.00	360.38	345.69	8.300	8	- 4.8	4.146	0.554	6.7
10.25	361.84	347.14	8.295	8	- 4.7	4.164	0.557	6.7
10.50	363.29	348.60	8.289	8	- 4.6	4.183	0.559	6.7
10.75	364.75	350.06	8.283	8	- 4.5	4.201	0.562	6.8
11.00	366.22	351.52	8.277	8	- 4.4	4.220	0.564	6.8
11.25	367.68	352.99	8.271	8	- 4.3	4.238	0.567	6.8
11.50	369.16	354.46	8.266	8	- 4.2	4.257	0.569	6.9
11.75	370.64	355.94	8.260	8	- 4.2	4.276	0.572	6.9
12.00	372.12	357.42	8.254	8	- 4.1	4.295	0.574	7.0
12.25	373.60	358.91	8.248	8	- 4.0	4.314	0.577	7.0
12.50	375.09	360.40	8.242	8	- 3.9	4.333	0.579	7.0
12.75	376.59	361.89	8.236	8	- 3.8	4.352	0.582	7.1
13.00	378.09	363.39	8.230	8	- 3.7	4.371	0.584	7.1
13.25	379.59	364.89	8.224	8	- 3.6	4.390	0.587	7.1
13.50	381.10	366.40	8.219	8	- 3.5	4.410	0.589	7.2
13.75	382.61	367.91	8.213	8	- 3.4	4.429	0.592	7.2
14.00	384.13	369.43	8.207	8	- 3.3	4.449	0.595	7.2
14.25	385.65	370.95	8.201	8	- 3.2	4.468	0.597	7.3
14.50	387.17	372.48	8.195	8	- 3.1	4.488	0.600	7.3
14.75	388.70	374.01	8.189	8	- 3.0	4.508	0.603	7.4
15.00	390.24	375.54	8.183	8	- 2.9	4.527	0.605	7.4
15.25	391.78	377.08	8.177	8	- 2.8	4.547	0.608	7.4
15.50	393.32	378.62	8.171	8	- 2.7	4.567	0.611	7.5
15.75	394.87	380.17	8.165	8	- 2.6	4.587	0.613	7.5
16.00	396.42	381.72	8.159	8	- 2.5	4.608	0.616	7.5
16.25	397.98	383.28	8.153	8	- 2.4	4.628	0.619	7.6
16.50	399.54	384.84	8.147	8	- 2.3	4.648	0.621	7.6
16.75	401.10	386.41	8.141	8	- 2.2	4.669	0.624	7.7
17.00	402.67	387.98	8.134	8	- 2.2	4.689	0.627	7.7
17.25	404.25	389.55	8.128	8	- 2.1	4.710	0.630	7.7
17.50	405.82	391.13	8.122	8	- 2.0	4.731	0.632	7.8
17.75	407.41	392.71	8.116	8	- 1.9	4.751	0.635	7.8
18.00	409.00	394.30	8.110	8	- 1.8	4.772	0.638	7.9
18.25	410.59	395.89	8.104	8	- 1.7	4.793	0.641	7.9
18.50	412.19	397.49	8.098	8	- 1.6	4.814	0.644	7.9
18.75	413.79	399.09	8.092	8	- 1.5	4.835	0.646	8.0
19.00	415.39	400.70	8.085	8	- 1.4	4.857	0.649	8.0
19.25	417.00	402.31	8.079	8	- 1.3	4.878	0.652	8.1
19.50	418.62	403.92	8.073	8	- 1.2	4.900	0.655	8.1
19.75	420.24	405.54	8.067	8	- 1.1	4.921	0.658	8.2
20.00	421.86	407.17	8.061	8	- 1.0	4.943	0.661	8.2